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Coronal Mass Ejection Research Using Solar Mass Ejection Imager (SMEI) Data

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Approved for public release; distribution is unlimited.

13. SUPPLEMENTARY NOTES

14. ABSTRACT

This report results from a contract tasking University of Birmingham as follows: The contractor will investigate data collected on coronal mass ejections (CME), and attempt to construct images of CMEs as they move towards the earth and predict their arrival. The objective of this research is to create a mathematical model for predicting the arrival and severity of geomagnetic storms resulting from CMEs.

15. SUBJECT TERMS

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Third Year Report for SPC 02-4043 (Contract F61775-02-WE043)

"Coronal Mass Ejection Research Using Solar Mass Ejection Imager (SMEI) Data"

This contract provides partial support for Dr S.J. Tappin to work on the SMEI program. During the last year he has continued to address the corrections needed to the SMEI images in order to take into account the gradual increase in the number of hot pixels in the CCD chips. he has also played a significant role in disseminating the scientific results from SMEI to the public.

Operating the instrument

Tappin has developed the expertise to address the corrections needed to the SMEI images in order to take into account the gradual increase in the number of hot pixels in the CCD chips. He has continued to refine the software to study the variance of the CCD pixels and the way this changes with the temperature of the individual cameras. It has turned out that the anneals that we had been doing at a temperature of 45 C were only partially successful, and that over the course of a few months the noise levels in the cameras gradually returned to their pre-anneal values. The maximum annealing temperature we can achieve for the sunward-facing camera is around 85 C, but we do not wish to cycle the CCD chip too often at this temperature for fear of damaging the CCD bonding to the camera cold-finger. We have now adopted a sequence of anneals based on Tappin's recommendations which are approximately every 2 months for camera 3 at maximum temperature, and around every 2 months at an 80% duty cycle for cameras 1 and 2. Occasionally we need to perform a high temperature anneal.

The number of bad pixels in camera 3 is increasing and in the normal operating mode, where for efficient use of telemetry and on-board computing power the CCD pixels are binned 2x2, one bad pixel results in that 2x2 bin being bad. We are developing a technique for mitigating this problem by first determining from the weekly calibrations, which are done in engineering mode where the data from each camera is transmitted at full resolution, which pixels are bad. We then are planning to modify the on-board flat-fielding table to eliminate at the pixel level those pixels that are bad. Then when the normal mode is resumed with the new flat-field table, a 2x2 bin will simply not contain the bad pixel. This is a complicated task, and Tappin and Mr M. P. Cooke (the on-board software engineer at Birmingham) have developed the expertise to handle it.

The SMEI team were successful in their proposal a special session to discuss SMEI results at the Fall AGU meeting, 2004. Tappin has contributed three papers for this session.

In summary, the software efforts have proved to be invaluable to the SMEI team, and Tappin is continuing to develop the diagnostic and end-user software. He is also working on the data analysis to refine the background subtraction software so that we can hopefully be able to detect corotating interaction regions. These are high speed stream-stream interactions in the solar wind, which form compression regions of enhanced density, which should be visible at the SMEI sensitivity. He has also submitted a paper on the way coronal mass ejections move from the Sun, through the SMEI field of view, and on out the the Ulysses spacecraft, which for this study was almost at 5 AU.

George Simnett

Birmingham

18 May 2005